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May 13, 1954

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ESTIMATED RADIATION DOSE TO THYROID OF NATIVES FROM RONGELAP

This memorandum is in reply to your request for an estimate of additional doses to the thyroid of the Rongelap natives due to the fact that tellurium, as a precursor to iodine, may be present in the gut after ingestion of fallout material. The tellurium, in turn, might disintegrate into radioactive iodine while in the gut, with subsequent deposition of the iodine in the thyroid.

There are some 17 radioactive isotopes of tellurium but only 7 of these are produced in fission. Of these, 6 are not of interest (4 have too short a half-life, 1 leads to stable_iodine-127 and 1 leads to iodine-129 with a half-life of 2-4 x 10^7 years). The remaining radioisotope is tellurium-132, with a half-life of 77 hours leading to iodine-132 with a half-life of 2.4 hours. (Incidentally there is no tellium precursor that is of interest here.)

Without having the original data of IASL I have accepted their estimate that there were ingested and/or inhaled the products of 5×10^{13} fissions, assumed they were all ingested, and then proceeded to calculate the dose to the thyroid from (a) 1^{131} (b) each shortlived iodine isotope of interest and (c) the added dose coming from $T^{1,32}-I^{1,32}$. The calculations show that $T^{1,32}-I^{1,32}$ will produce an added dosage of about 26%.

The best estimated percentage absorption and deposition of iodine is yet to be determined. The best estimate I can turn up to date is still the 20% quoted in NBS Handbook 52. However, I will continue to search for additional information. In the meantime the table below indicates the magnitude of doses to the thyroid if one assumes 20, 50, and 100% absorption and deposition. Incidentally, it may be noted that the calculations below based on 20% (the number assumed by IASL) show estimated doses to the thyroid from I131 and from shorter lived iodine isotopes to be in good agreement with those estimated by IASL, i.e., 50 reps for I¹³¹ and 80 reps for short-lived iodine isotopes.

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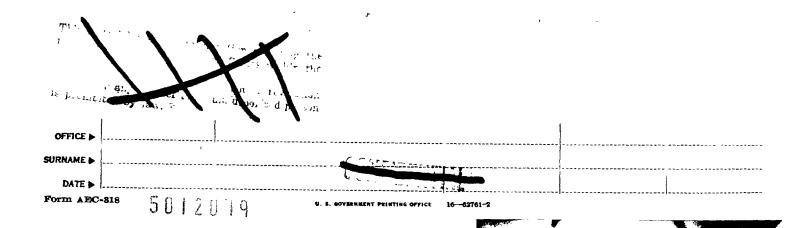
DOSE TO THIROID (REPS)

| 1131 1132 1133 1135 1132(Te ¹³²) | Asenming 100% Retention | | Assuming 50% Retention | | Assuming 20% Retention | |
|--|---|--|--|--|-------------------------------------|---|
| | 255 27* 370 60 185* 897* | 255 (54)*** 370 60 (370)** (1109)** | 128 114 185 30 93* 150* | 128 (27)** 185 30 (185)** (555)** | 51 5* 74 12 37* 189* | 51 (10)** 74 12 (74)** (221)** |

* If assume that one-half of the I¹³² (half-life 2.4 hours) present in the gut is deposited in the thyroid.

** If assume all of the I¹³² (half-life 2.4 hours) present in the gut is deposited in thyroid.

Most probable estimate of ratio of doses to thyroid is:



ANNEX

Calculations of Dose to Thyroid

7131

Assume: inhalation and/or ingestion of 5×10^{13} . fissions

At D \neq 1 there are 0.017 d/m/10 000 fissions

or $8.5 \times 10^7 \text{ d/m/5} \times 10^{13} \text{ fissions}$

or 38.3 pc intake of I131

or 1.4 x 10^{12} atoms intake of I^{131}

(Average energy 0.22 Mev)

Dose (reps) =
$$(1.35 \times 10^{12})^{*}(0.22)(1.6 \times 10^{-6})$$

(20)(93)

= 255 -eps

Correction for biological decay.

I¹³²

Assume: inhalation and/or ingestion of 5 x 10^{13} fissions At D \neq 1, I¹³² intake is 1.1 x 10^{11} atoms

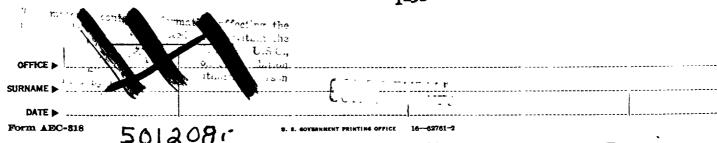
The average mean energy of I^{132} is about 0.55 mev or 2.5 times that of I^{131} .

Thus, the energy equivalent to I131 would be

 $(1.1 \times 10^{11})(2.5) = 2.75 \times 10^{11}$ atoms of I¹³¹

However, due to the short half-life of I^{132} (2.4 hrs) assume that the energy equivalent of 1.5 x 10^{11} atoms of I^{131} reaches the thyroid.

Thus, the ratio of doses $\frac{131}{132} = 9.0$



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I133

Assume: inhalation and/or ingestion of 5 x 10¹³ fissions

At D f 1, I¹³³ intake is 1.2h x 10¹² atoms

The average mean energy of I¹³³ is about 0.36 or 163 times that of I¹³¹.

Thus, the ratio of doses I¹³¹ = 0.7

1135

Assume: inhalation and/or ingestion of 5 x 10^{13} fissions At D \neq 1, I¹³⁵ intake is 2.36 x 10^{11} atoms.

The average mean energy of I¹³⁵ is about 0.3 meV or 1.36 that of I¹³¹.

Thus, the energy equivalent to I^{131} would be $(2.36 \times 10^{11})(1.36) = 3.2 \times 10^{11} \text{ atoms of } I^{131} \text{ energy}$ equivalent.

Thus, ratio of doses $\frac{1131}{1135} \approx 4.2$

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52 132 77 hr. 7 1132 2.4 hrs. 754 (stable)

Assume: inhalation and/or ingestion of 5×10^{13} fissions.

At B / 1, Tel32 intake 100 pc

or 1.5 x 10¹² atoms

Assume: the time spent in the gut is 77 hrs.

Then, 7.3 x 10^{11} atoms of Te^{132} will have disintegrated into 7.3 x 10^{11} atoms of I^{132} .

The average mean energy of I 132 is about 0.55 New or 2.5 times that of I 131.

Thus, the energy equivalent to I would be

 $(7.3 \times 10^{11})(2.5) = 1.8 \times 10^{12}$ atoms of I¹³¹.

However, due to the short half-life of I^{132} (2.4 hrs), assume that only the energy equivalent of 1 x 10^{12} atoms of I^{131} reaches the thyroid.

Thus, the ratio of doses $\frac{1131}{1132(hel32)} = 1.4$.

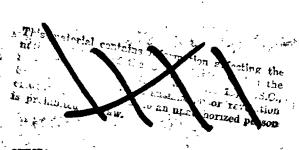
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